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September 30, 2003

To: Scott Brown, U.S.E.P.A., Helena, MT.

From: Douglas J. Dollhopf, Pam Blicher and Dennis Neuman

Re: **Estimated Area In Helena Valley Where Total Soil Lead Concentrations Exceed 500 mg/kg (Map 2).****Objective**

- Identify areas in the Helena Valley where the total soil lead concentration may exceed 500 mg/kg as a function of a specified probability.

Results are exhibited on attached Map 2. Support calculations are presented below.

**Literature Used In Support Of These Following Calculations**

CH2M Hill. 1987. Remedial investigation of soils, vegetation and livestock for the East Helena site (ASARCO), East Helena, Montana. U.S.E.P.A., Helena, MT., pages 3.46-3.52.

Dollhopf, D. J. 2003. Estimated area in Helena Valley where total soil lead concentrations exceed 500 mg/kg. Memorandum to S. Brown, U.S. EPA, Helena (January 9). Reclamation Research Unit, Bozeman, MT. 2 p.

**Helena Valley Area Where Total Soil Lead Concentration Is Greater Than 500 mg/kg**

Using geostatistics, a semivariogram and associated kriged maps (Figures 3.4 and 3.5, CH2M Hill 1987) were prepared that depicted soil lead across the Helena Valley for the 0-4 inch depth increment. The following calculation was developed to determine the area within the Helena Valley where there is less than a 2.5 % probability that total soil lead concentration is greater than 500 mg/kg. Total soil lead values used for this analysis are presented in Appendix Table 1.

**Less Than 2.5 % Probability Calculation**

- On Figure 3.5, the area encompassed by the 2.70 ( $\log_{10}$ ) isopleth line is composed almost entirely of soils having greater than 500 mg/kg total lead. Total soil lead concentrations

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greater than 500 mg/kg will be encountered outside the 2.70 ( $\log_{10}$ ) isopleth line, but there is less than a 2.5 % probability of locating such soil concentrations outside the 2.23 ( $\log_{10}$ ) line on Figure 3.5. The 2.23 ( $\log_{10}$ ) isopleth line equates to a total soil lead concentration of 170 mg/kg. The calculation in support of this finding follows.

•One tailed t-value @ n = 157 @ 97.5 % confidence = 1.96

As shown on Figure 3.4, a standard error of 0.24 is appropriate to use for the soil area containing greater than 500 mg/kg Pb.

$$2.23 + (0.24)(1.96) = 2.7$$

$$10^{2.7} = 500 \text{ mg/kg Pb}$$

In Figure 3.5, the line labeled 2.23 ( $\log_{10}$ ) encompasses an area of 8457 acres, approximately 4.5 by 5.0 miles, beyond which there is less than a 2.5 % probability of locating a soil concentration greater than 500 mg/kg.

#### **A Note Of Caution**

This kriged map can be used to provide guidance on soil lead concentrations across the Helena Valley and to aid in design of field sampling efforts. Although statistical levels of confidence can be calculated for lead concentration lines shown on Figure 3.5, caution should be exercised when making an interpretation. This map was developed using a predictive model based on 157 soil samples across the Helena Valley. Because cleanup decisions for individual properties need to be based on exact boundaries of soil arsenic concentrations, additional soil sampling and associated laboratory analysis must be done to define these boundaries with higher levels of confidence.

Also, note that these results are for the 0-4 inch soil depth increment. The Helena Valley area where total soil lead concentrations exceed 500 mg/kg may yield a different result if the soil sampling depth was changed.

See Appx.1 of Oct. 9 memo.



